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Indian Standard

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(Reaffirmed 2022)

वायुरुद्ध संपीडक — विशिष्टि

(दूसरा पुनरीक्षण)

Hermetic Compressors — Specification

(Second Revision)

ICS 23.140; 97.040.30

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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Refrigeration and Air Conditioning Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1983 in three parts and subsequently revised after merging all the three parts in 2013.

The major changes in this revision are as follows:

a) Different types of compressor mechanisms like scroll, rotary, reciprocating including linear is added;
b) Variable speed compressors, DC compressors; and
c) Compressors for various systems other than traditional HVAC applications.

This standard has been formulated to assist manufacturers and users as a common guide for performance evaluation and rating of hermetically sealed refrigeration compressors.

In the formulation of this standard considerable assistance has been derived from the following International Standards:

ANSI/ASHRAE Standard 23.1-2010	Methods of testing for rating the performance of positive displacement refrigerant compressors and condensing units that operates at subcritical temperatures of the refrigerant
CAN/ANSI/AHRI 540-2015	Performance rating of positive displacement refrigerant compressors and compressor units
BS EN 12900 : 2013	Refrigerant compressors — Rating conditions, tolerances and presentation of manufacturer's performance data
IEC 60335-2-34 : 2012	Household and similar electrical appliances — Safety — Part 2-34: Particular requirements for motor compressors

The composition of the committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the rules of the test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HERMETIC COMPRESSORS — SPECIFICATION

(Second Revision)

1 SCOPE

1.1 This standard deals with the safety and performance requirements of hermetic sealed type standalone motor-compressors operating on vapor compressor cycle, suitable for low, medium and high temperature applications based on reciprocating (including linear), rotary and scroll pump mechanisms, their protection system, if any, which are intended for use in equipment for house hold, industrial and commercial purposes.

1.2 It applies to motor-compressors tested separately under the most severe conditions that may be expected to occur in normal use, their rated voltage being not more than 260 V for single-phase motor-compressors and not more than 480 V for other motor-compressors. This standard also covers:

a) Multi-speed **motor-compressors**, that are **motor-compressors**, the speed of which can be set to different values; and

b) Variable capacity **motor-compressors**, that are **motor-compressors** where the capacity of the compressor is controlled at fixed speeds.

NOTE — Examples of equipment which contain motor-compressors are:

a) refrigerators, food freezers and ice makers;

b) air-conditioners, electric heat pumps and dehumidifiers;

c) commercial dispensing appliances and vending machines; and

d) factory-built assemblies for transferring heat in applications for refrigerating, air-conditioning or heating purposes or a combination of such purposes.

1.3 This standard does not cover semi-hermetic compressor.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of the standards. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
5111 : 1993 /ISO 917 : 1989	Testing of refrigerant compressors (*first revision*)
1271 : 2012/ IEC 60085 : 2007	Electrical insulation — Thermal evaluation and designation (*second revision*)
4831 : 2018	Recommendation on units and symbols for refrigeration

3 TERMINOLOGY

For the purpose of this standard the following definitions shall apply.

3.1 Hermetically Sealed Compressor — A machine consisting of an electrically driven refrigerant pump housed in a container which is welded or brazed together to form a gas tight shell also called as housing. The machine cannot be taken apart without cutting open the container housing and has no access to internal moving parts. The electrical windings are exposed to both the refrigerant and the compressor lubricating oil. There are various types of hermetically sealed compressors using different pumping mechanisms as below

3.1.1 *Reciprocating Compressors* — These compressors use a pump mechanism of piston cylinder arrangement to compress the refrigerant gas. The rotary motion of the motor shaft is converted to reciprocating motion for compressor.

3.1.2 *Rotary Compressors* — These compressors use a impeller type of piston vane combination having rotary motion to compressor the refrigerant gas.

3.1.3 *Scroll Compressors* — These compressors use a combination of fixed and moving scroll sets, moving scroll have a mechanism to covert rotary mechanism into orbital motion to compressor refrigerant gas.

3.1.4 *Linear Compressor* — These compressors are a type of reciprocating compressor, uses a mechanism wherein the piston moves in the linear track to compress the refrigerant gas.

3.2 Refrigerating Capacity — It is calculated from the product of mass flow rate and the difference between the enthalpy of the refrigerant vapour entering the compressor suction at a temperature and pressure and the enthalpy of the condensed refrigerant liquid at a temperature and pressure measured just before

the expansion valve. The refrigerating capacity is expressed in watts (W).

3.3 Power Input

3.3.1 *For Motor Compressors* **—** The electrical power input at the motor terminals (including accessories, if any):

a) For motor compressors with a specific means of factory assembled or factory specified frequency inverter for variable speed, the electrical power input at the inverter input terminals.

b) For variable speed motor compressors without a factory specific frequency inverter the electrical power input shall be at motor terminals.

3.4 Coefficient of Performance (COP) — The compressor efficiency termed as coefficient of performance (COP) is defined as the ratio of refrigerating capacity in Watts, to the power input in Watts.

3.5 Bubble Point — Refrigerant liquid saturation temperature at a specified pressure. It is the temperature at which the first bubble of vapour forms in liquid refrigerant (saturated liquid).

3.6 Dew Point — Refrigerant vapour saturation temperature at a specified pressure. It is the temperature at which the first droplet of liquid forms in refrigerant vapour (saturated vapour).

The evaporating and condensing temperatures at rating point shall correspond to dew point.

3.7 Subcooling — Difference between the bubble point temperature of the refrigerant corresponding to the compressor discharge pressure and the temperature of the liquid refrigerant below the bubble point.

3.8 Suction Gas Superheat — Difference between the dew point temperature of the refrigerant corresponding to the compressor suction pressure and the suction gas temperature of the refrigerant at the compressor inlet.

3.9 Starting Methods — The hermetic compressors have following types of starting methods or as defined by manufacturer:

Single Phase	Types
RSIR	Resistance Start Induction Run
CSIR	Capacitor Start Induction Run
PSC	Permanent Split Capacitor
CSR	Capacitor Start and Run
PTCSIR	Positive Temperature Co-efficient Start Induction Run
PTCSCR	Positive Temperature Co-efficient Start Capacitor Run
Three Phase	Star/Delta
DC Voltage	Electronic Controller

4 CLASSIFICATION OF COMPRESSORS

4.1 The compressors shall be classified based on the evaporating range as given in Table 1.

4.2 The precise limits of the evaporating temperature range shall be according to declared compressor specifications. Classification in Table 1 is indicative only.

5 RATING AND TEST CONDITIONS

5.1 Compressor Capacity Rating Test

The capacity of the hermetic compressor shall be evaluated at any of the specified test conditions as given in Tables 2, 3 and 4, as per compressor specification.

Table 1 Classification of Compressors

(*Clause* 4.1)

Sl No.	Category	Usage	Evaporating Temperature Range (°C)
(1)	(2)	(3)	(4)
i)	Low back pressure (LBP)	Refrigerating and freezing domestic and commercial applications	-35 to -10
ii)	Commercial back pressure/Medium back pressure (CBP/MBP)	Commercial applications	-20 to +10
iii)	High back pressure (HBP)	a) Air-conditioning application	-5 to +13.9
		b) Commercial/Heat pump application	-23.3 to 12.8

NOTE — In case of zeotropic mixtures, the evaporating temperatures and condensing temperatures shall correspond to its dew point.

Table 2 Normal Load Conditions LBP

(*Clause* 5.1)

Sl No.	Item	Unit	Household and Commercial Refrigeration Applications	Commercial and Industrial Refrigeration Applications
(1)	(2)	(3)	(4)	(5)
i)	Evaporating temperature[1]	°C	-23.3	-35
ii)	Condensing temperature[1]	°C	54.4	40
iii)	Ambient temperature	°C	32.2	35
iv)	Compressor suction gas temperature	°C	32.2	20
v)	Temperature of sub-cooled liquid	°C	32.2	40
vi)	External cooling of compressor		Natural convection or any other system specified by the manufacture	
vii)	Voltage	V	Rated voltage ±1 percentage	
viii)	Frequency	Hz	Rated frequency ± 1 percentage	

NOTE — In case of zeotropic mixtures, the evaporating temperatures and condensing temperatures shall correspond to its dew point.

[1] Refer to charts of refrigerant properties for saturation temperature and corresponding pressures.

Tolerance on pressures shall be ± 1 percentage

Tolerance on temperature (Sl. No. iii, iv, v) shall be +/-3°C

Table 3 Normal Load Conditions (CBP/MBP)

(*Clause* 5.1)

Sl No.	Item	Unit	Household and Commercial Refrigeration Applications	Commercial/Industrial Refrigeration Applications
(1)	(2)	(3)	(4)	(5)
i)	Evaporating temperature[1]	°C	-6.7	-10
ii)	Condensing temperature[1]	°C	54.4	45
iii)	Ambient temperature	°C	35.0	35.0
iv)	Compressor suction gas temperature	°C	35.0	20
v)	Temperature of sub- cooled liquid	°C	46.1	45
vi)	External cooling of compressor		Natural convection or any other system specified by the manufacture	
vii)	Voltage	V	Rated voltage ±1 percentage	
viii)	Frequency	Hz	Rated frequency ± 1 percentage	

NOTE — In case of zeotropic mixtures, the evaporating temperatures and condensing temperatures shall correspond to its dew point.

[1] Refer to charts of refrigerant properties for saturation temperature and corresponding pressures.

Tolerance on pressures shall be ± 1 percentage

Tolerance on temperature (Sl. No. iii, iv, v) shall be +/-3°C

Table 4a Normal Load Conditions HBP (Air Conditioning Applications)

(*Clause* 5.1)

Sl No.	Item	Unit	Residential Air Conditioning Applications	Commercial Air Conditioning Applications
(1)	(2)	(3)	(4)	(5)
i)	Evaporating temperature[1]	°C	7.2	7.2
ii)	Condensing temperature[1]	°C	54.4	54.4
iii)	Ambient temperature	°C	35.0	35.0
iv)	Compressor suction gas temperature	°C	35.0	18.3
v)	Temperature of sub- cooled liquid	°C	46.1	46.1
vi)	External cooling of compressor	Natural convection or any other system specified by the manufacture		
vii)	Voltage	V	Rated voltage ±1 percentage	
viii)	Frequency	Hz	Rated frequency ± 1 percentage	

[1] Refer to charts of refrigerant properties for saturation temperature and corresponding pressure.

Tolerance on pressure shall be ± 1 percent.

Tolerance on temperature (Sl. No. iii, iv, v) shall be +/-3°C

Table 4b Normal Load Conditions HBP (Commercial Cooling / Heating Applications)

(*Clause* 5.1)

Sl No.	Item	Unit	Commercial Cooling Applications	Commercial Cooling / Heating Applications
(1)	(2)	(3)	(4)	(5)
i)	Evaporating temperature[1]	°C	7.2	5
ii)	Condensing temperature[1]	°C	54.4	50
iii)	Ambient temperature	°C	35.0	35
iv)	Compressor suction gas temperature	°C	35	20
v)	Temperature of sub- cooled liquid	°C	46.1	50
vi)	External cooling of compressor	Natural convection or any other system specified by the manufacture		
vii)	Voltage	V	Rated voltage ± 1 percentage	
viii)	Frequency	Hz	Rated frequency ± 1 percentage	

NOTES (Applicable to Table 2,3 4a and 4b)

1 For any other condition of liquid sub-cooling, encountered in actual test, test results shall be corrected by calculation, back to the value.

2 The manufacturer shall specify the maximum and minimum operating pressure and temperature conditions for the safe operation of the compressor.

3 For variable speed AC compressors with drive, frequency of testing shall be as per compressor specification.

4 For fixed speed DC compressors with drive voltage of testing shall be as per compressor specification.

5 For dual voltage rating compressor, test voltage is determined as below:

Dual voltage can be of 2 types;

a) For example, 220/240 V: means the product shall either run at 220 V or 240 V. The test can be carried out at either of the voltages or both

b) For example, 220 – 240 V: which means a range, the test shall be carried out at mean voltage that is, 230 V.

6 TESTING

The compressor tests shall be divided into two categories:

a) *Type tests* — To be performed on representative sample. These tests shall consist of the tests that would be necessary to check up the performance and characteristics of the units and components.

b) *Routine tests* — These shall consist of routine tests that would be conducted on each and every unit during production.

6.1 Type Tests

The type tests shall consist of the tests that would be necessary to check up the performance and characteristics of the units and components.

6.1.1 *Compressor Performance Test*

The performance testing of hermetic compressors shall be carried out by any of the methods given in IS 5111 depending on construction of test equipment. The observed performance values when measured under stabilized conditions, described in clause **5.1** shall be as per Table 5.

NOTE — Reference to IS 5111 has been made only for purposes of selection of test method or procedure or equipment and not for any test conditions mentioned there.

6.1.2 *Startability Test*

6.1.2.1 The compressor shall be able to start at the voltage (as per **6.1.2.3** and **6.1.2.4**). This is applicable to single phase compressors only.

In case of dual voltage rating for same frequency, the test shall be carried out at the lower rated voltage.

This test is not applicable to three phase, variable speed and DC compressor.

6.1.2.2 *Start test conditions*

The start test to be conducted at the pressures equal to the saturation temperatures listed in Table 6.

6.1.2.3 *Cold startability test*

The cold start test shall be carried out with the conditions mentioned in Table 6 and ambient temperature at 25~35°C. The compressor shall start and run at 85 percent of the rated voltage.

6.1.2.4 *Hot startability test*

The compressor shall be run at rated voltage and frequency till steady state is achieved as per **5.1** (that is, three successive readings of the temperature, taken at approximately 10 min intervals), then switched OFF to achieve pressures at saturated temperatures mentioned in Table 6 and then switched ON. The compressor shall start and run at minimum voltage, as per the compressor specification. Test shall be repeated 3 times for consistency in results after achieving pressure as specified in **5.1**.

6.1.3 *Locked Rotor Test with Accessories*

The compressor with overload protection system shall undergo short duration locked rotor testing. The locked rotor condition is obtained by blocking the movement of rotor and/or piston on specimen

Table 5 Actual Performance in Relation to Specified Data

(*Clause* 6.1.1)

Sl No.	With Respect to Compressor Specification	HBP	CBP/ MBP	LBP
(1)	(2)	(3)	(4)	(5)
i)	Minimum refrigerating capacity	95.0 Percent	92.5 Percent	90.0 Percent
ii)	Maximum power absorbed at rating points	105.0 Percent	105.0 Percent	105.0 Percent
iii)	Minimum COP	90.0 Percent	90.0 Percent	90.0 Percent

Table 6 Start Test Conditions

(*Clause* 6.1.2)

Sl No.	Item	LBP	MBP	HBP
(1)	(2)	(3)	(4)	(5)
i)	Saturated evaporating temperature °C	15	32.2	32.2
ii)	Saturated condensing temperature °C	15	32.2	32.2
NOTE — Tolerance on saturated temperature +2°C. Refer to charts of refrigerant properties for saturation temperature and corresponding pressures.				

compressor. The compressor shall be charged with oil, if necessary, and vapour refrigerant. The rated voltage is to be applied when the compressor is kept under ambient temperature not exceeding 35°C. In case of dual rated voltage compressors, test shall be performed at higher rated voltage. The test shall be conducted for 3 h or until shell / housing temperature is stabilized within ±5°C, whichever is earlier.

At the end of the test:

a) the motor-compressor protection system shall be able to operate;
b) the temperature of the housing and the temperature of the accessible surfaces of associated components shall not exceed 150°C;
c) the leakage current at 1.06 times the rated voltage for single phase and 1.06 times the rated voltage divided by root 3 for three-phase shall not exceed 3.5 mA; and
d) compressor shall withstand high voltage test as per **6.1.4.**

This test is applicable to compressors with self-resetting motor protector only.

6.1.4 *High Voltage Test*

The compressor shall be able to withstand 1.5 kV AC voltage for 1 min/s without breakdown. The leakage current measured shall not exceed 5 mA. This test shall not be repeated on the same compressor.

6.1.5 *Leakage Current*

Test to be carried as per IS 302-1 or IEC 60335-2-34.

6.1.6 *Pneumatic Test of Shell*

The shells shall be tested pneumatically (dry air/ nitrogen) at a test pressure of 1MPa (gauge) and shall not show any leakage**.**

6.1.7 *Bursting Test*

Housings shall withstand the pressure expected in normal use.

Compliance is checked by the following tests:

A housing which is exposed to high side pressure shall be subjected to a pressure equal to:

a) for non-sub critical refrigeration systems, a minimum of 3.5 times the saturated vapour pressure of the refrigerant at 70 °C, rounded up to the next 0.5 MPa (5 bar).

   NOTE — Example of test pressure calculation for R-22 (subcritical)

   Saturated vapour pressure at 70°C (gauge with respect to atmospheric pressure at STP) = 2.89 MPa (28.9 bar)

   Test pressure = 3.5 × 2.89 MPa (28.9 bar)

   = 10.1 MPa (101 bar)

   = 10.5 MPa (105 bar) when rounded up to the next 0.5 MPa (5 bar).

b) for sub critical refrigeration systems, 3 times the design pressure but not less than the minimum test pressure as required in Table 7.

The test values for some refrigerants are given in Table 7. The values may, however, not be high enough for some applications.

A housing which is exposed only to low side pressure shall, for both subcritical and trans critical applications, be subjected to a pressure equal to five times the saturated vapour pressure of the refrigerant at 20°C or equal to 2.5 MPa (25 bar) whichever is higher, rounded up to the next 0.2 MPa (2 bar).

NOTE — Example of test pressure calculation for R-22 (subcritical):

Saturated vapour pressure at 20 °C (gauge with respect to atmospheric pressure at STP) = 0.81 MPa (8.1 bar)

Test pressure = 5 × 0.81 MPa (8.1 bar)

= 4.05 MPa (40.5 bar)

= 4.2 MPa (42 bar) when rounded up to the next 0.2 MPa (2 bar).

The test values for some refrigerants are given in Table 8. The values may, however, not be high enough for some applications.

For refrigerant blends, the saturated vapour pressure is taken as the pressure at the dew point temperature.

The test shall be carried out on two samples. The test samples are filled with a liquid, such as water, to exclude air and are connected in a hydraulic pump system. The pressure is raised gradually until the required test pressure is reached. This pressure is maintained for 1 min during which time the sample shall not leak.

6.2 Holding Charge

All compressors shall have a positive charge of 0.03 MPa to 0.1 MPa of dry air/nitrogen having a dew point not more than -40°C or as per the mutual agreement between the supplier and the buyer.

6.3 Routine Tests

These shall consist of routine tests that would be conducted on each and every unit during manufacturing/ after completion at the manufacturer's works.

Routine tests shall consist of the following:

a) High voltage test at 1.5 kV and 5mA leakage current for 1s;
b) Insulation test at 500V DC; the insulation resistance shall be not less than 2 M Ω; and
c) The housing shall be tested pneumatically (dry air/nitrogen/helium) at a test pressure of 1MPa (gauge) and shall not show any leakage.

   NOTE — Avoid high voltage repeat test on the same compressor.

Table 7 Minimum High Side Test Pressure

(*Clause* 6.1.7)

Sl No.	Refrigerant Formulae	Refrigerant Number	Test Pressure	
			Mpa	Bar
(1)	(2)	(3)	(4)	(5)
	Non-Subcritical			
i)	CF_3CH_2F	R-134a	6.5	65
ii)	$CHClF_2$	R-22	10.5	105
iii)	$CH(CH_3)_3$	R600a	3.5	35
	by weight 73.8 percent R-12 + 26.2 percent R-152a	R-500	10	100
	by weight 48.8 percent R-22 + 51.2 percent R-115	R-502	10.5	105
	by weight 44 percent R-125 + 52 percent R-143a + 4percent R134a	R-404A	10	100
	by weight 50 percent R-125 + 50 percent R-143a	R-507A	11	110
	by weight 25 percent R-125 + 52 percent R-134a + 23 percent R-32	R-407C	10.5	105
	by weight 50 percent R-125 + 50 percent R-32	R-410A	15	150
iv)	CH_3-CH_2-CH_3	R-290	10.5	105
	Trans-critical			
vi	CO_2	R-744	42	420

Table 8 Minimum Low Side Test Pressure

(*Clause* 6.1.7)

Sl No.	Refrigerant Formulae	Refrigerant Number	Test Pressure	
			(Mpa)	(Bar)
(1)	(2)	(3)	(4)	(5)
	Non-Subscritical			
i)	CF_3CH_2F	R-134a	2.5	25
ii)	$CHClF_2$	R-22	4.2	42
iii)	$CH(CH_3)_3$	R-600a	2.5	25
	by weight 73.8 percent R-12 + 26.2percent R-152a	R-500	2.9	29
	by weight 48.8 percent R-22 + 51.2 percent R-115	R-502	4.5	45
	by weight 44percent R-125 + 52percent R-143a + 4percent R134a	R-404A	5	50
	by weight 50 percent R-125 + 50percent R-143a	R-507A	5.5	55
	by weight 25percent R-125 + 52percent R-134a + 23percent R-32	R-407C	4	40
	by weight 50percent R-125 + 50percent R-32	R-410A	7	70
iv)	CH_3-CH_2-CH_3	R-290	4.2	42
	Subcritical			
v)	CO_2	R-744	28.6	286

7 RUNNING OVERLOAD TEST

The compressor shall have built in protection system. It may be bi-metallic thermal overload protection or electronically controlled protection system. The protection system can be either internal to the compressor or placed externally. The compressor shall be capable of withstanding the overload on calorimeter/ test bench tests as given in Table 9.

The motor compressor when supplied at 1.06 times the rated voltage, the protector shall not trip during the overload test conditions as specified in Table 9 for 2 h running. In case of dual rated voltage higher voltage to be considered.

The test is repeated with supply voltage equal to 0.94 times the rated voltage and then 0.85 times the rated voltage. In case of dual rated voltage lower voltage lower voltage to be considered.

The test is further continued by reducing the voltage in steps of 4 percent ± 1 percent of the rated voltage until OLP trips. Next step of voltage to be applied when the compressor reaches steady state condition.

The procedure is continued until one of the following conditions occurs:

a) The motor-compressor protection system operates; and

b) The motor-compressor stalls and steady conditions are reached;

At the time of trip the winding temperature shall not exceed 150°C for compressors with cellulosic insulation and 160°C for compressors with synthetic insulation. For other insulating material winding temperature limit may be defined by the manufacturer.

This test is not applicable to variable speed and DC compressors.

7.1 Calculation for Winding Temperature

Following equation shall be used to calculate the winding temperature:

$$\text{Winding temperature} = R2 / R1 (k + t) - k$$

where,

R1 = Resistance at beginning of test at test ambient;

R2 = Resistance at end of test at test ambient;

k = 234.5 for copper and 225 for aluminum; and

t = Room/ test ambient.

8 LOCKED ROTOR TEST

8.1 The compressor with overload protection system shall undergo locked rotor testing as a design verification test. This test is applicable to compressors with self-resetting motor protector only. The locked rotor condition is obtained by blocking the movement of rotor and/or piston on specimen compressor. The compressor shall be charged with oil, if necessary, and vapour refrigerant. The rated voltage is to be applied when the compressor is kept under ambient temperature not exceeding 35°C. The system shall be tested for 2 000 cycles or for 15 days which is applicable as below.

8.2 If 2 000 cycles of the protection system have not been performed by the end of the 15 day period, the test may be considered complete provided the following conditions are met - the housing temperature is recorded on the 12th and 15th days. If, during this three day period, the temperature has not increased by more than 5 K, the test can be considered complete.

8.3 If the temperature has increased by more than 5 K, the test is to be continued until the temperature has not increased by more than 5 K over a period of three consecutive days or for at least 2 000 cycles of the motor-compressor protection system, whichever occurs first

8.4 In case of dual rated voltage compressors, test shall be performed at higher rated voltage. After completing the above test, the test shall further be carried out at lower voltage for 3 h.

Table 9 Overload Test Conditions

(*Clause* 7)

Sl No.	Application Category	Evaporation Temperature °C	Condensation Temperature °C	Motor-Compressor Ambient Temperature °C	Return Gas Temperature °C
(1)	(2)	(3)	(4)	(5)	(6)
i)	Low back pressure	-15	+65	+43	+43
ii)	Medium back pressure	0	+65	+43	+25
iii)	High back pressure	+12	+65	+43	+25

NOTE — If compressor test conditions are out of the operating envelop, then conduct the test at the worst case within the operating envelop defined by the compressor manufactures with same ambient and return gas temperature as mentioned in the above table. Applicable to compressors that cannot be tested as per Table 9 only.

8.5 At the end of the test following requirement shall be met:

a) Motor-compressor protection system shall be able to operate;

b) Temperature of the housing and the temperature of the accessible surfaces of associated components shall not exceed 150°C;

c) Leakage current, at 1.06 times the rated voltage for single phase and 1.06 times the rated voltage divided by root 3 for three-phase shall not exceed 3.5 mA; and

d) Compressor shall withstand high voltage test as per **6.3**.

9 RESISTANCE TO RUSTING

As per **31** of IS 302-1.

10 SPECIFICATION

Following additional information shall be provided by the manufacturer:

a) Type - Hermetic;

b) Displacement/revolution;

c) Refrigerant type;

d) Application group/range of evaporating temperature;

e) Refrigeration capacity at rating conditions;

f) Electrical characteristics, such as nominal voltage, voltage range, phases, frequency and nominal input power;

g) Method of cooling;

h) Starting methods;

j) Wiring diagram with details of start relay/ capacitors, run capacitors, overload protectors, etc.;

k) External physical dimensions and pipe connections (Compressor Drawing);

m) Compressor weight;

n) Quantity of oil and its grade; and

p) Co-efficient of performance.

11 MARKING

11.1 The compressor shall have the following information marked on a nameplate in a permanent and legible manner in a location, where it is accessible and visible:

a) Name of manufacturer and country of origin;

b) Type or model number and serial number of the unit;

c) Month and year of manufacture;

d) Rated voltage, phase and frequency: product rated for dual voltage / dual frequency to be marked as dual voltage and dual frequency;

e) Locked rotor current;

f) Current at rated conditions or maximum continuous current (optional); and

g) Refrigerant or refrigerant group;

NOTE — Locked Rotor Amperes (LRA) not to be mentioned for variable speed.

11.2 BIS Certification Marking

Each compressor may also be marked with the Standard Mark.

11.2.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations made there under. The details of theconditions under which the licence for use of the Standard Mark may be granted to the manufacturers or the producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Refrigeration and Air Conditioning Sectional Committee, MED 03

Organization	*Representative(s)*
Indian Institute of Technology, Roorkee	Prof (Dr) Ravi Kumar (***Chairman***)
Annapurna Electronics and Services Ltd, Hyderabad	Shri G. K. Prasad Shri J. S. Sastry (*Alternate*)
Bureau of Energy Efficiency, New Delhi	Shri Saurabh Diddi Shri Manjeet Singh (*Alternate*)
Blue Star Ltd., Mumbai	Shri Jitendra Bhambure Shri Sunil Jain (*Alternate*)
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TO

IS 10617 : 2018 HERMETIC COMPRESSORS — SPECIFICATION

(Second Revision)

(*Page* 5, *clause* **6.1.2.1,** *sentence* 2) — Substitute the following for the existing sentence:

'This is applicable to single phase induction motor compressors only.'

(*Page* 5, *clause* **6.1.2.4,** *sentence* 2) — Substitute 'The compressor shall start and run at the minimum of the voltage range defined by the compressor specification.' *for* 'The compressor shall start and run at minimum voltage, as per the compressor specification'.

(*Page* 5, *clause* **6.1.3,** *sentence* 3) — Substitute 'The compressor shall be charged with oil and if necessary, vapor refrigerant' *for* 'The compressor shall be charged with oil, if necessary, and vapour refrigerant.'

(*Page* 6, *clause* **6.1.4**) — Substitute 'The compressor shall be able to withstand min 1.5 kV AC voltage for 1 s without breakdown' *for* 'The compressor shall be able to withstand 1.5 kV AC voltage for 1 min/s without breakdown'.

(*Page* 6, *clause* **6.1.6**) — Delete.

(*Page* 6, *clause* **6.1.7,** *para* 1) — Substitute the following for the existing para:

'Housings shall withstand the pressure expected in normal use. Housing shall be subjected to low side pressure or high side pressure or both pressure in normal use as per the design of hermetic compressors. The evaluation shall be carried out determining which part of the shell is subjected to high or low side or both

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pressures as per the compressor design. Wherever needed, specially built samples with or without assembly inside are subjected to this test, the high pressure side shell or portion of shell is to be subjected to high side test pressure and low pressure side shell or portion of shell is to be subjected to low side test pressure.'

(*Page* 6, *clause* **6.2**) — Substitute 'as per the manufacturer's specification' *for* 'as per the mutual agreement between the supplier and the buyer'.

[*Page* 6, *clause* **6.3, a**)] — Substitute 'High voltage test at minimum 1.5 kV and 5 mA leakage current for 1s' *for* 'High voltage test at 1.5 kV and 5 mA leakage current for 1s'.

[*Page* 6, *clause* **6.3, b**)] — Delete.

[*Page* 6, *clause* **6.3, c**)] — Substitute 'The housing shall be tested pneumatically (dry air/nitrogen/helium) at a test pressure of minimum 1Mpa (gauge) and shall not show any leakage' *for* 'The housing shall be tested pneumatically (dry air/nitrogen/helium) at a test pressure of 1MPa (gauge) and shall not show any leakage.'

(*Page* 7, *Table* **7** *and* **8**) — Insert the following note under the table:

'NOTE — For the refrigerants not mentioned in the table, test pressure as per IS/ISO 17584 is to be used. For refrigerants not mentioned in either the table or IS/ISO 17584, refrigerant manufacturer's data sheet is to be referred for the test pressure.'

(*Page* 8, *clause* **7**) — Substitute the following for the existing:

'The compressor shall have built in protection system. It may be bi-metallic thermal overload protection or electronically controlled protection system. The protection system can be either internal to the compressor or placed externally. The compressor shall be capable of withstanding the overload test on calorimeter/ test bench tests as given in Table 9.

The motor-compressor including the motor-compressor protection system or motor-compressor control system, if any, is operated under the appropriate conditions given in Table 9 so as to cause the motor-compressor protection system to operate or to reach steady conditions with the motor-compressor in the stalled or running condition. The testing shall be conducted at rated voltage and stabilized for 2 h.

After stabilization, the test voltage shall be increased to 1.06 times of rated voltage to stabilize and the motor protection system shall not trip. In case of dual rated voltage, highest voltage is to be considered as the test voltage.

The test is then repeated with voltage reduced to 0.94 times of rated voltage and 0.85 times of rated voltage. In case of dual rated voltage, lowest voltage is to be considered as the test voltage.

During test, if the motor-compressor protection system does not operate, the voltage is decreased (or increased in case the protector trips at 0.85 times rated voltage to find the start voltage) in steps of 4 percent ± 1 percent of the rated voltage, at a rate of approximately 2 V/min, until steady conditions are reached at each step. This procedure is continued until one of the following conditions occurs:

a) the motor-compressor protection system operates; or

b) the motor-compressor stalls and steady conditions are reached.

NOTE — Stabilized conditions are considered to be obtained when three successive readings of the temperature, taken at approximately 10 min intervals, at the same point of any operating cycle, does not differ by more than -273°C (1 K).

At the time of trip, the winding temperature shall not exceed 150°C for compressors with cellulosic insulation and 160°C for compressors with synthetic insulation. For other insulating material winding temperature limit may be defined by the manufacturer. This test is not applicable to variable speed and DC compressors.

NOTES:

1 For single phase (induction motor) compressor, motor protector is connected in series with the common winding. When the protector trips, since individual resistance measurement is not possible, resistance shall be measured across start and run winding connections that is, combined winding resistance. This combined winding resistance shall be used for calculating winding temperature.

2 For 3 phase (induction motor) compressor the protector is connected in the star connection of the winding. Considering this, winding resistance measurement after protector trips is not possible. Hence, winding resistance shall be measured as below:

i) Run the compressor at the voltage just before the protector trip to achieve steady state condition; and

ii) Shut down the power supply to the compressor to measure the winding resistance. The winding temp is calculated on the basis of this winding resistance.'

(*Page* 8, *clause* **8.1,** *sentence* 4) — Substitute 'The compressor shall be charged with oil and if necessary, vapor refrigerant.' *for* 'The compressor shall be charged with oil, if necessary, and vapour refrigerant.'

(*Page* 8, *clause* **8.1**) — Insert the following note at the end of clause:

'NOTE — Locked rotor test required on all compressor type which have auto reset protection system (including electronic protection system when provided with the compressor).'

(*Page* 9, *clause* **9**) — Substitute the following for the existing:

'Resistance to rusting shall be as per Annex B'.

(*Page* 11, ANNEX A) — Insert the following new Annex:

'ANNEX B

RESISTANCE TO RUSTING

(*Clause* 9)

B-1 GENERAL GUIDELINES

This specification governs the inspection and testing procedures of paint and or rust preventive coating applied on compressor shell.

All surfaces shall be completely painted. Carry out the test at a temperature of (25 ± 5) °C and a relative humidity of below 80 percent, unless otherwise agreed.

Wet dip painted items must have three (3) to five (5) days curing time before testing. Powder painted items are cured when cooled.

Manufacturer's can either refer to the test methods given in **B-2** or refer to the ISO methods as below:

Sl No.	*Property / Evaluation*	*ISO Method*
(1)	(2)	(3)
i)	Dry film thickness	ISO 2808 : 2019
ii)	Paint adhesion by cross cut test	ISO 2409 : 2020
iii)	Paint cure test	ISO 2808 : 2019

B-2 TEST METHODS

B-2.1 Dry Film Thickness Test

The paint thickness will be measured by means of a dry film thickness gauge. Several measurements will be taken on various locations on the sample. As a minimum requirement following locations are to be covered:

a) Two locations each on the shell front, back and 2 sides; and

b) One location each on top, bottom of shell and on the mounting bracket or legs.

An average value for the entire sample will be recorded as the paint thickness. This average paint thickness measured shall comply with the manufacturer quality control specification.

B-2.2 Paint Adhesion by Cross Cut Test

Scribe number of cuts in each direction of the lattice pattern that is, in horizontal and 90 degree direction, minimum cuts shall be six. The cuts shall be parallel lines through the finish to the base metal by use of a carbide-tipped scribe or multi blade scribing tool. The cuts shall be made such that there are definite intersection points between the horizontal and vertical cuts. The lines should be approximately as follows:

a) up to 60 μm: 1 mm (minimum) spacing, for hard (e.g. metal and plastics) substrates;

b) 61 μm to 120 μm: 2 mm (minimum) spacing, for both hard and soft substrates; and

c) 121 μm to 250 μm: 3 mm (minimum) spacing, for both hard and soft substrates.

The length of the lattice/ square thus produced may be 50 mm or as derived by the manufacturer's specification.

Press a strip of scotch brand #600 tape or equivalent having same surface energy over the scribed area. Remove the tape rapidly. The removal of more than 15 percent of squares will be cause for rejection of the sample due to poor paint adhesion. Table 10 shows the six-step classification of cross-cut test result.

Table 10 Classification of Test Results

(*Clause* B-2.2)

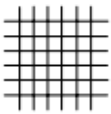
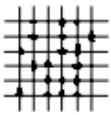
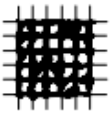
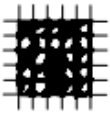
Sl No.	Classification	Description	Appearance of surface of cross-cut area from which flaking has occurred [1)] (Example of six parallel cuts)
(1)	(2)	(3)	(4)
i)	0	The edges of the cuts are completely smooth; none of the squares of the lattice is detached.	
ii)	1	Detachment of small flakes of the coating at the inter-sections of the cuts. A cross-cut area not greater than 5% is affected.	

Table 10 (*Concluded*)

Sl No.	Classification	Description	Appearance of surface of cross-cut area from which flaking has occurred [1)] (Example of six parallel cuts)
(1)	(2)	(3)	(4)
iii)	2	The coating has flaked along the edges and/or at the intersections of the cuts. A cross-cut area greater than 5%, but not greater than 15%, is affected.	
iv)	3	The coating has flaked along the edges of the cuts partly or wholly in large ribbons, and/or it has flaked partly or wholly on different part of the squares. A cross-cut area greater than 15%, but not greater than 35%, is affected.	
v)	4	The coating has flaked along the edges of the cuts in large ribbons and/or some squares have detached partly or wholly. A cross-cut area greater than 35%, but not greater than 65%, is affected.	
vi)	5	Any degree of flaking that cannot even be classified by classification 4.	—

[1)] The figures are examples of cross-cut within each step of the classification. The percentages stated are based on the visual impression given by the pictures and the same percentages will not necessary be reproduced with digital imaging.

B-2.3 Paint Cure Test

Paint cure shall be tested as follows in the area of the shell where the greatest heat sink or thermal mass is located:

a) Measure the paint film thickness in the area to be tested and record this reading as the initial paint thickness;

b) Saturate a small area of a Kim wipe, cheesecloth, or similar white material with the appropriate solvent for the paint being tested:

   1) Epoxy powder paint — Methyl Ethyl Ketone (MEK) or Acetone

2) Alkyd enamel dip paint — Methyl Ethyl Ketone (MEK) or Acetone

3) Hybrid polyester/epoxy powder — Xylene

c) Rub the paint surface with the solvent soaked cloth for 25 double rubs;

d) Inspect the surface of the material for paint. Record your observations (that is, no paint, slight amount of paint, moderate paint residue, and heavy paint residue); and

e) Measure the paint film thickness after the solvent rub and record this as the final paint film thickness. The loss more than 15 percent, based on an average of 5 measurements after 25 double rubs, will constitute a cure failure.'